Introduction to Botany. Lecture 4

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Outline

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Previous final question: the answer

What is the difference between primary and secondary cell wall?

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What is the difference between primary and secondary cell wall?

- Primary: non-oriented cellulose, water, “living”
- Secondary: dense, strongly oriented cellulose, lignin and/or suberin, “dead”

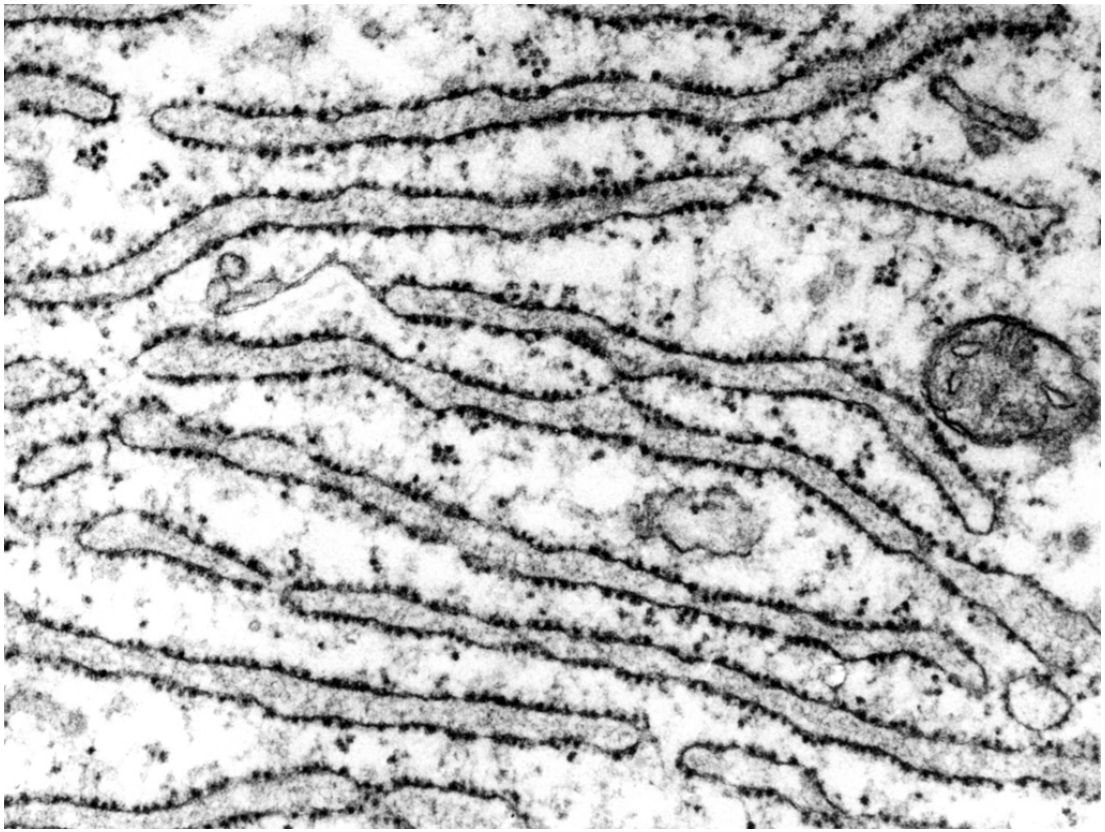
Vacuoles, osmosis and turgor pressure

- If cell vacuoles contain more concentrated solution of salts then water surrounding cell (i.e., water outside is *hypotonic*), water will flow inside a cell. It is called **osmosis**
- Cell wall prevents cell from explosion due to high **turgor pressure**
- When water flows outside a cell, cell content will shrink: this is **plasmolysis**

Symplast and apoplast

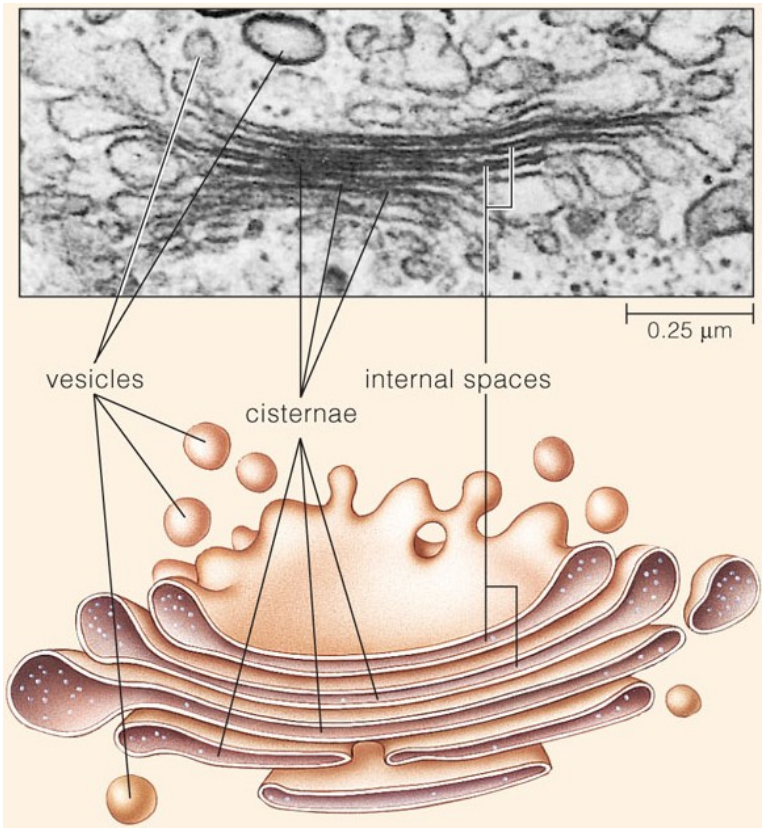
- **Symplast** — name for continuous cytoplasm in set of cells
- **Apoplast** — space outside cell; area of considerable metabolic activity

Endoplasmatic reticulum (network), ER



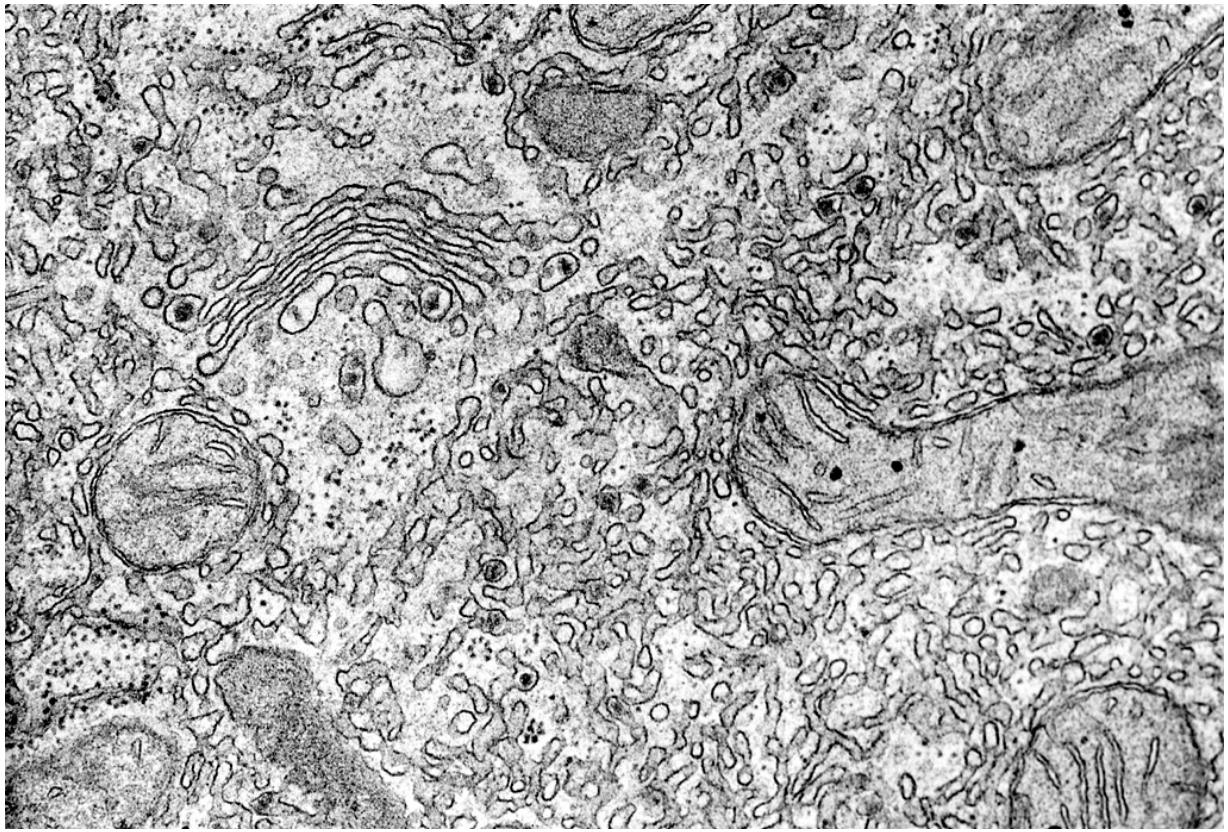
Rough endoplasmic reticulum with ribosomes along outer surface. Manufactures many proteins destined for secretion or for incorporation into membranes (TEM)

Goldgi apparatus (dictyosomes) 1



The Golgi is an organelle composed of stacks of flattened, membranous sacs mainly responsible for modifying, packaging, and sorting proteins that will be secreted or targeted to other organelles of the internal membrane system or to the plasma membrane

Goldgi apparatus (dictyosomes) 2



Golgi complex and smooth endoplasmic reticulum in a liver cell (TEM)

Nucleus structure

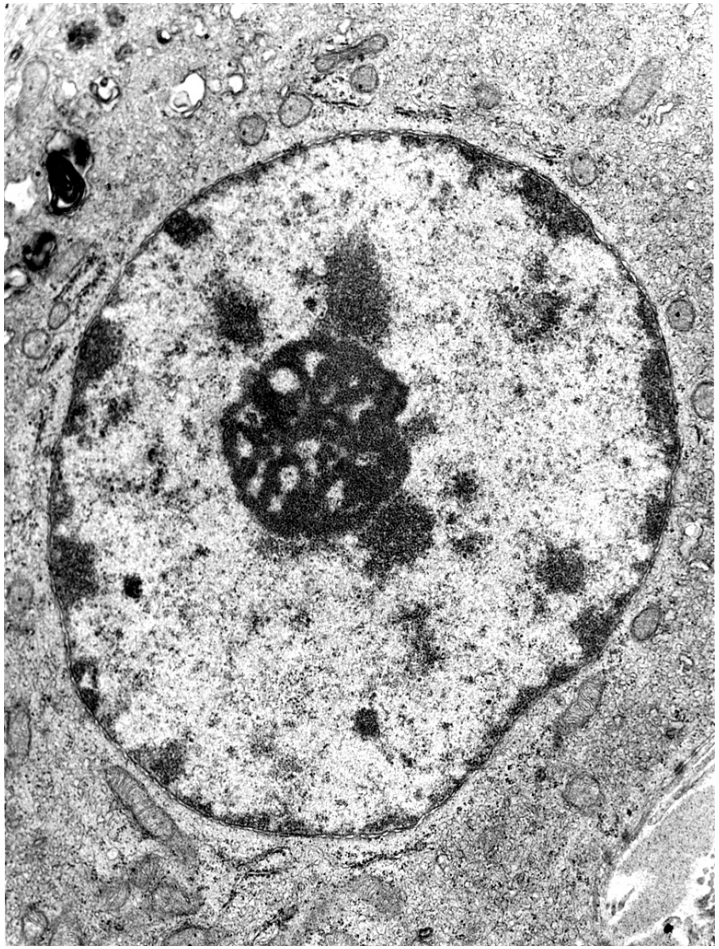
Nuclear envelope Double layered membrane, filaments of protein lamin line inner surface and stabilize structure, inner and outer membranes connect to form pores

Nucleoplasm Portion inside the nuclear envelope

Nucleoli Dark staining bodies within nucleus, site for ribosome synthesis

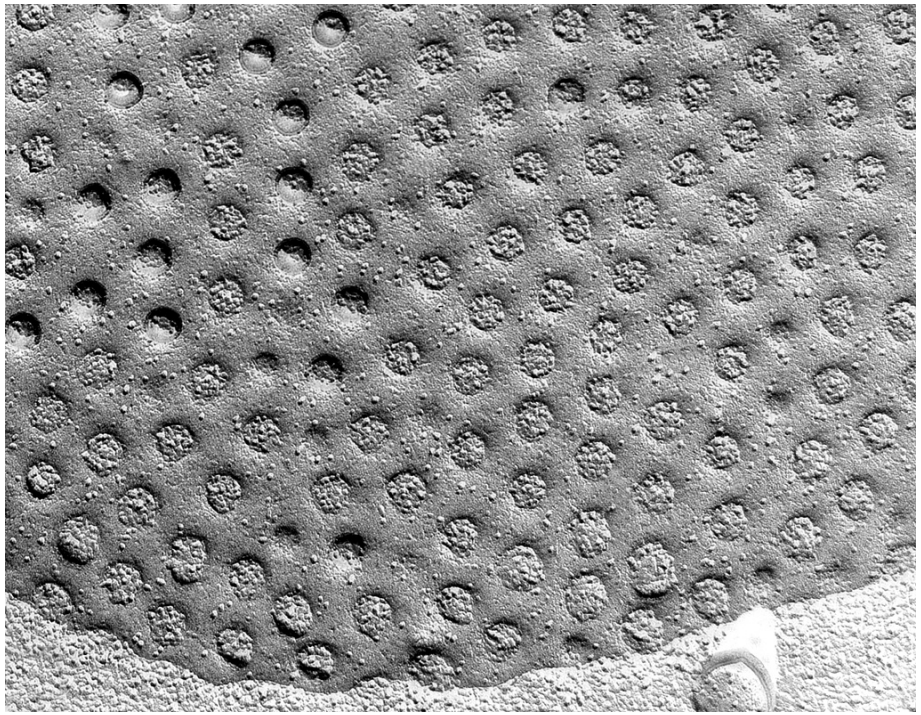
Chromosomes Store genetic information in nucleotide sequences, each chromosome consists of chain of nucleosomes (long DNA molecule and associated histone proteins)

Nucleus



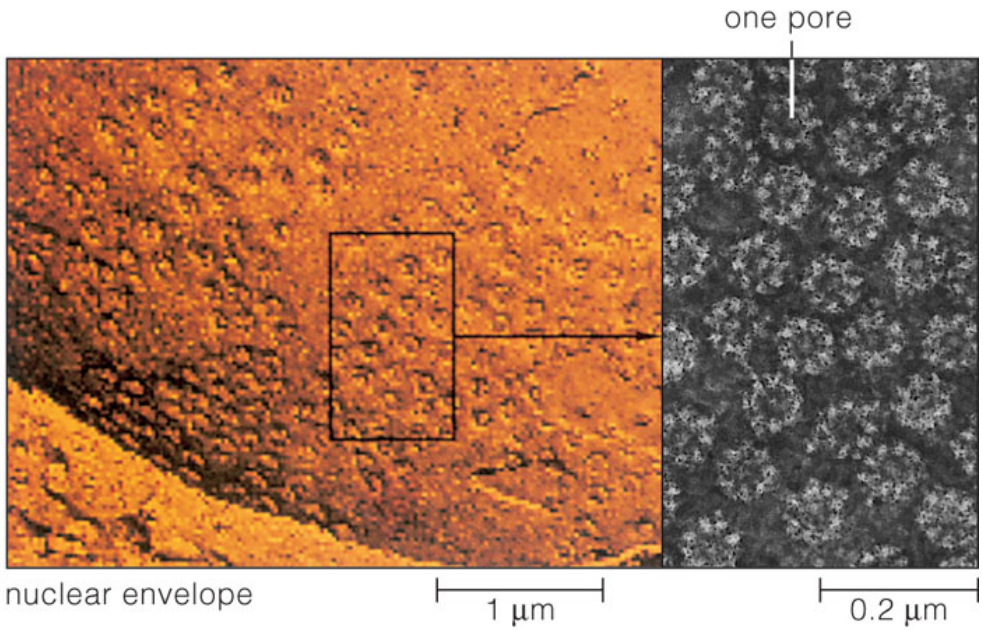
A typical nucleus with a prominent nucleolus (TEM).

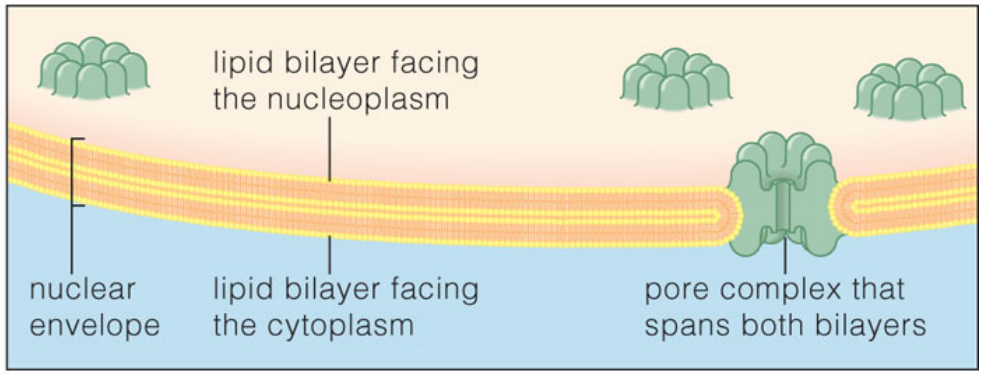
Nuclear pores



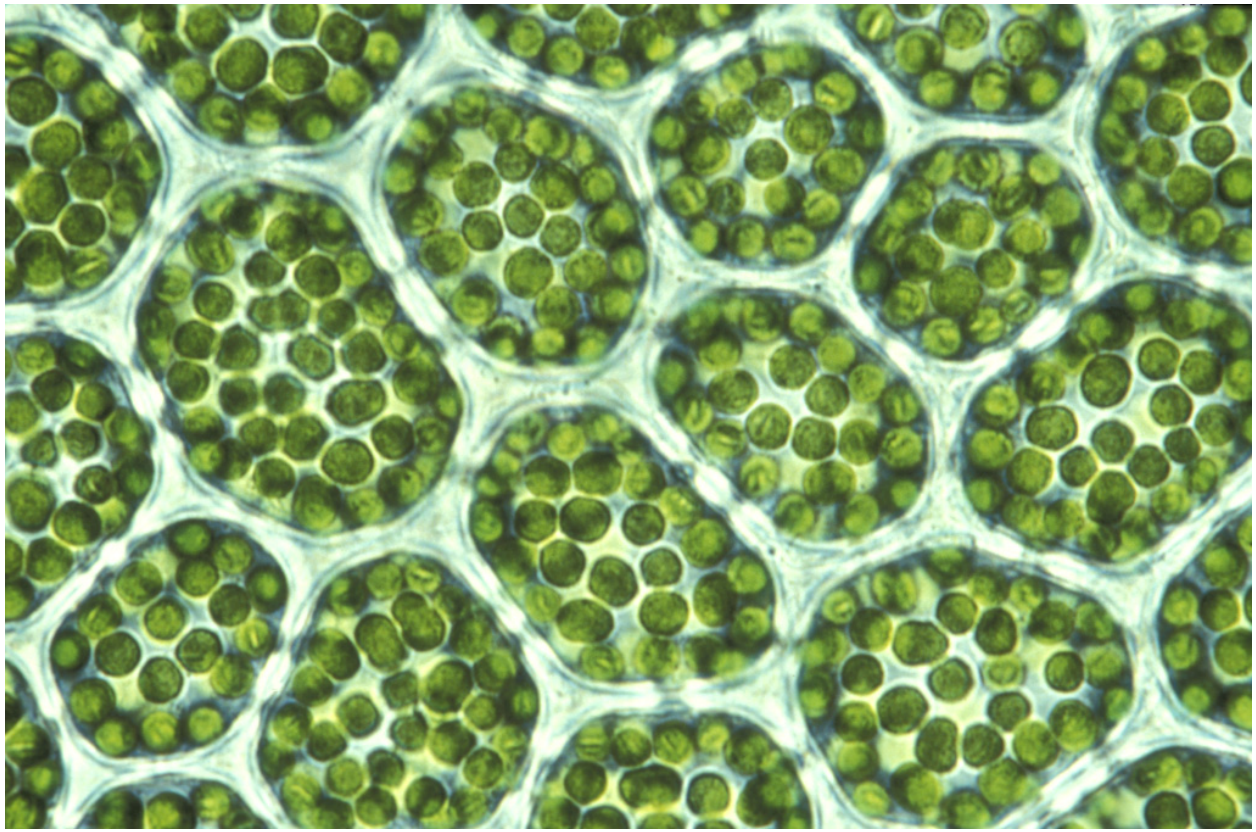
Freeze-fracture technique used to show nuclear pores. Nuclear pores are structures in the nuclear envelope that allow passage of certain materials between the cell nucleus and the cytoplasm (TEM $\times 100,000$)

Nuclear pores and envelope



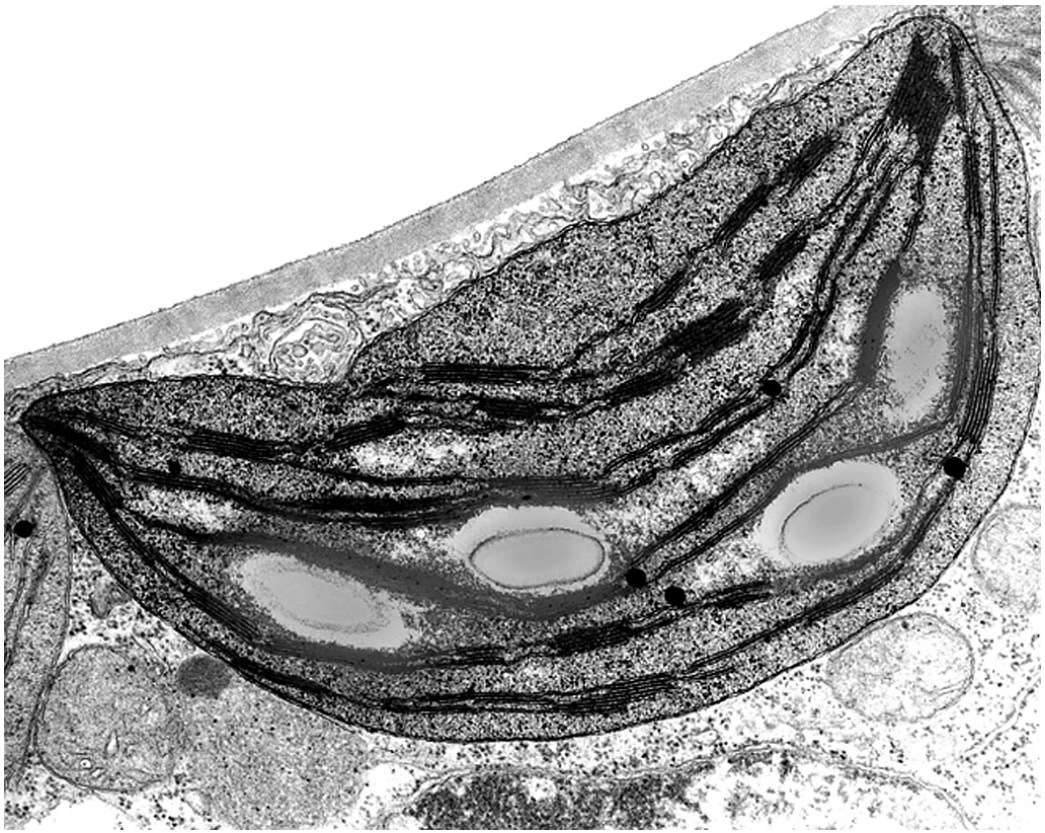


Plastids



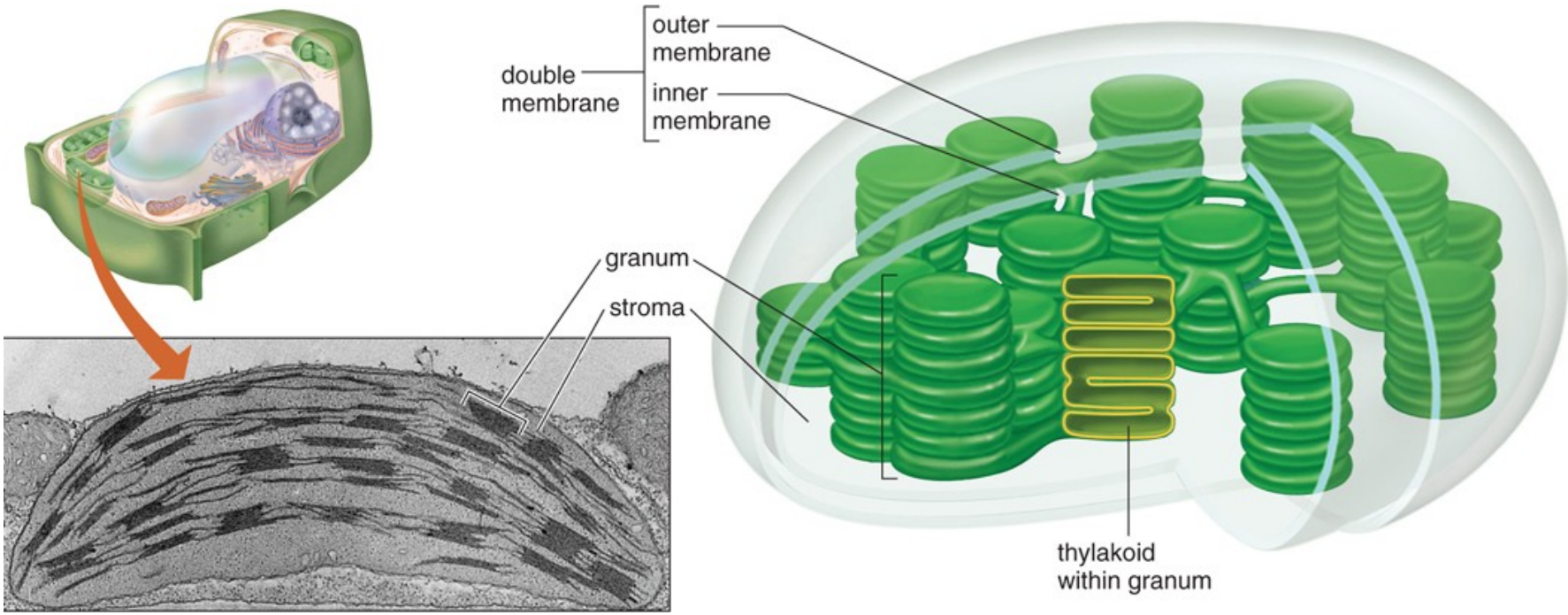
Chloroplasts in leaf cells of *Rhizomnium pseudopunctatum* (LM $\times$500)

Plastid structure

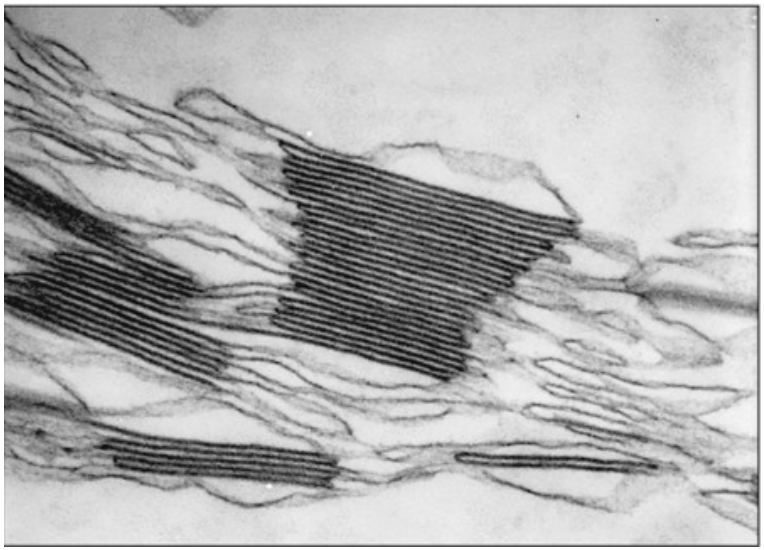


Tylacoids, stroma and starch granules (TEM $\times 37,500$)

Scheme of plastid



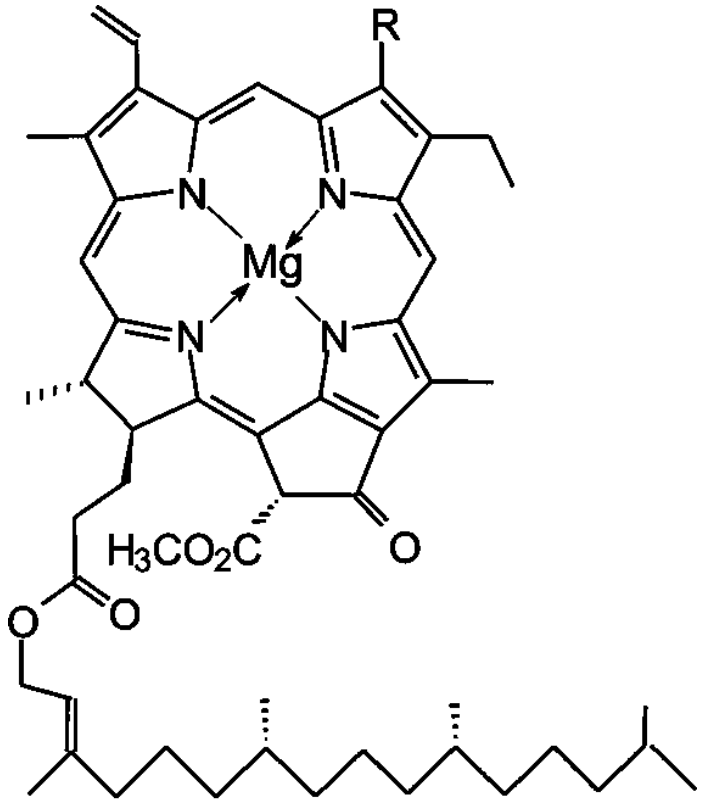
Grana



Pigments

- Chlorophylls (*a* and *b*) are photosynthetic lipids, including magnesium (Mg)
- Carotenoids facilitate photosynthesis, responsible for autumn colors

Chlorophylls *a* and *b*

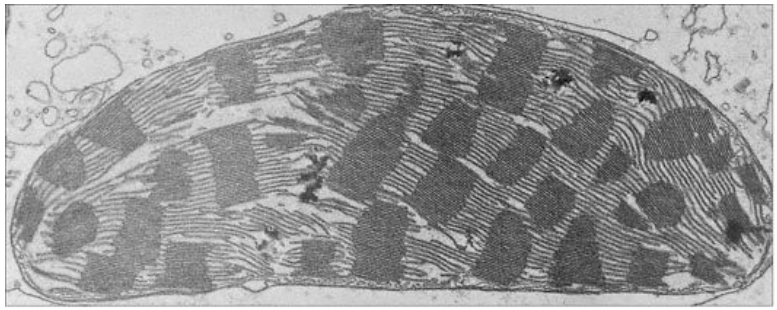


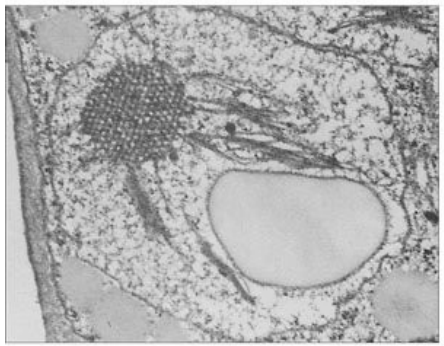
chlorophyll *a* (R = CH_3)
chlorophyll *b* (R = CH=O)

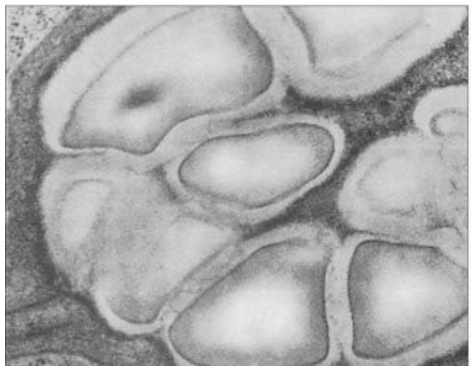
Plastid types

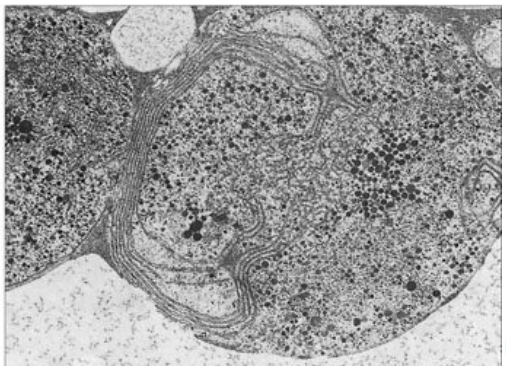
- **Chloroplast** (from “chloro-” = “yellow-green”). Photosynthesis, convert light energy into chemical energy, store carbohydrates as starch grains
- **Leukoplast** (from “leuko-” = “white”). Store carbohydrates in form of starch
- **Amyloplast** (from “amylo-” = “starch”). Leukoplasts that contain large granules of starch
- **Chromoplast** (from “chromo-” = “color”). Stores carotenes and xanthophylls, give orange-to-red color to certain plant tissues.

Plastid types: chloro-, leuco-, amylo- and chromo-









Mitochondria

Mitochondrion showing foliate *cristae* and matrix granules.

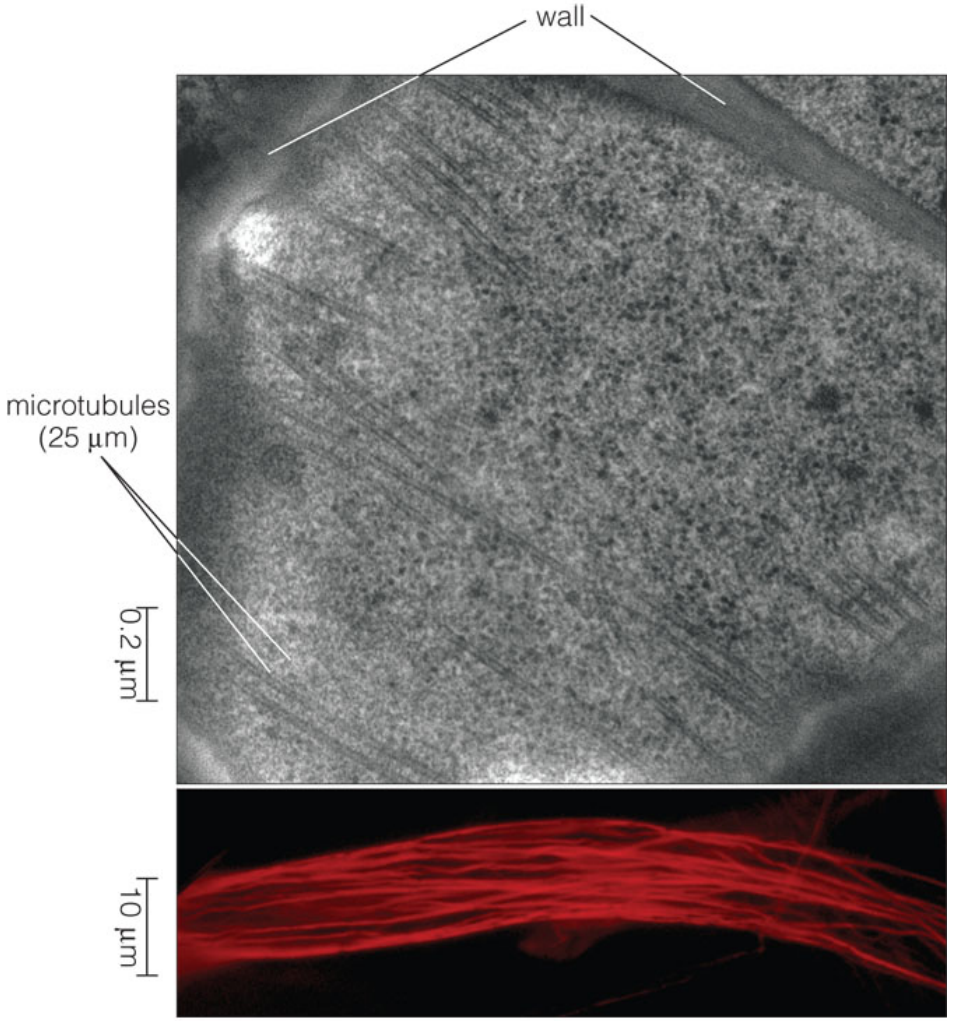
Mitochondria are the main energy source (in form of ATP) of the cell

Cellular skeleton

Collection of long, filamentous structures within cytoplasm:

- **Microtubules**. Movement based on tubulin-kinesins interactions. They are key organelles in cell division, form basis of cilia and flagella, serve as guides for movement of organelles within cell
- **Microfilaments**. Movement based on actin-myosin interactions. Serve as guides for movement of organelles within cell

Cytoskeleton



Plant and animal cells: differences

Final question (2 points)

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What is the difference between symplast and apoplast?

Summary

- There are **two ways** of moving things between plant cells: through symplast or through apoplast
- **ER** handles ribosomes and packages proteins
- **Golgi apparatus** guides the movement of proteins
- **Nucleus** stores and expresses genetic information
- **Plastids** convert energy of light to chemical energy and store starch
- **Mitochondria** make useful forms of chemical energy

For Further Reading

J. E. Bidlack, Sh. H. Jansky.
Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
Chapter 3.

Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapters 3.1–3.6.